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(21) International Application Number: PCT/US91/06098 (22) International Filing Date: 27 August 1991 (27.08.91) (71) Applicant: GENERAL ELECTRIC COMPANY [US/ US]; 1 River Road, Schenectady, NY 12345 (US). (72) Inventors: BORMAN, Willem, Frederik Hendri ; 209 Log- wood Drive, Evansville, IN 47712 (US). LIU, Nan-I ; 1604 Country Club Road , #D, Mount Vernon, IN 47620 (US). (74) Agents: KING, Arthur, M.; International Patent Opera- tion, General Electric Company, 1285 Boston Avenue, Bldg. 23CW, Bridgeport, CT 06602 (US) et al.		(81) Designated States: JP, KR, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IT, LU, NL, SE). Published <i>With international search report.</i>
(54) Title: POLY (ALKYLENE CYCLOHEXANEDICARBOXYLATE) - POLYCARBONATE COMPOSITIONS AND MODIFICATIONS (57) Abstract Compositions are provided which comprise a first polyester resin (A) which comprises the reaction product of at least one straight chain, branched, or cycloaliphatic C ₂ -C ₁₀ alkane diol or chemical equivalent thereof, and a cycloaliphatic diacid or chemical equivalent thereof; and (B) an aromatic polycarbonate resin, an aromatic polyester carbonate resin, an aromatic dihydric phenol sulfone carbonate resin, or a mixture of any of the foregoing. These compositions are transparent and hom- ogeneous. They exhibit a significantly higher stiffness than the individual components, retain excellent impact strength and are UV radiation stable. Also provided are modified compositions as above which optionally include an additional polyes- ter resin which may be the same as or different than the first polyester resin.		

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**POLY(ALKYLENE CYCLOHEXANEDICARBOXYLATE)-
POLYCARBONATE COMPOSITIONS AND MODIFICATIONS**

FIELD OF THE INVENTION

5 This invention relates to compositions comprised of (A) polyester resins comprising the reaction product of at least one straight chain, branched, or cycloaliphatic C_2-C_{10} alkane diol or a chemical equivalent thereof, and at least one cycloaliphatic diacid or a
10 chemical equivalent thereof; and (B) a polycarbonate resin, as well as to such compositions modified by the addition of an effective modulus modifying amount of a core-shell multi-stage polymer having a rubbery core derived from an acrylate or (meth)acrylate, a diene or a
15 mixture of any of the foregoing and a vinyl-based polymer or copolymer outer shell or of a vinyl cyanide-conjugated diolefin-alkyl aromatic ABS-type terpolymer. Also included are modified compositions further comprising an additional polyester resin which may be the same as or
20 different than the first polyester resin as well as filled and/or flame retardant compositions.

 These unmodified compositions are homogeneous and retain transparency. All of the compositions of the present invention, both modified and unmodified, exhibit
25 significantly higher stiffness than that of the individual components, enhanced melt flow, and retain excellent impact strength.

BACKGROUND OF THE INVENTION

30 Novel compositions comprising a polyester resin which is the reaction product of at least one straight chain, branched, or cycloaliphatic C_2-C_{10} alkane diol or a chemical equivalent thereof and at least one cycloaliphatic diacid or a chemical equivalent thereof

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combined with a polycarbonate resin have been discovered which are homogeneous and transparent, have significantly higher stiffness measured as flexural modulus than the modulus of either component, and retain excellent impact strength at a wide range of temperatures.

Modified compositions comprising the compositions above and an appropriate core-shell multi-stage polymer modifier or ABS-type polymer modifier as well as such modified compositions containing an additional polyester resin, retain superior stiffness and impact properties as well.

Weatherable, UV radiation resistant, solvent resistant, resilient, high impact polymers have great application in the manufacture of molded or thermoformed products such as automobile external parts, lawn and garden equipment, and sporting goods.

Crystallizable polyesters of cycloaliphatic diacids or derivatives thereof with aliphatic and/or cycloaliphatic diols have relatively high melting points and are quite UV resistant as they do not appreciably absorb near-UV light. Many of these polyesters were explored for use as hot melt adhesives. See, Jackson et al., J. Applied Polymer Review, Vol. 14, 685-98, (1970); U.S. Patent No. 3,515,628.

Wilfong, J. Polymer Sci., Vol. 54, 385-410 (1961), referred to polyesters of hexahydro terephthalic acid, the cis-/trans-mixture of cyclohexanedicarboxylic acids obtained by the hydrogenation of terephthalic acid. See, Caldwell et al, U.S. Patent No. 2,891,930 including poly(neopentyl cyclohexane dicarboxylate); Carpenter, Journal of Soc. Dyers and Colorists, Vol. 65, 469 (1941).

Kibler et al, U.S. Patent No. 2,901,466, disclose linear polyesters and polyester-amides prepared by condensing cis- and/or trans-1,4-cyclohexanedimethanol

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with one or more bifunctional reactants, which because of high melting temperatures, are advantageous for the preparation of fibers for use in fabrics and films for use as support for photographic emulsions.

5 Friction activatable solvent-free adhesives comprising a thermoplastic linear polyester derived from one or more saturated aliphatic dicarboxylic acid and/or aromatic dicarboxylic acids and one or more saturated aliphatic diols, a tackifier, and a plasticizer are
10 disclosed by Wayne et al, U.S. Patent No. 4,066,600.

Scott, U.S. Patent No. 4,125,572, describes a thermoplastic molding composition and articles molded therefrom that retain optical clarity comprising a polycarbonate, a poly(1,4-butylene terephthalate), and a
15 copolyester of an aliphatic or cycloaliphatic diol and a mixture of terephthalic and isoterephthalic acids. Scott discloses that blends of polycarbonate and polyalkylene terephthalate, as described in U.S. Patent No. 3,218,372, tend to lose their transparency when the amount of
20 poly(1,4-butylene terephthalate) is greater than about 10 percent or when they are heat aged.

Cohen et al, U.S. Patent No. 4,257,937, discuss compositions comprising a poly(1,4-butylene terephthalate) resin modified by a combination of a
25 polyacrylate resin and an aromatic polycarbonate resin.

Jackson et al, U.S. Patent No. 4,327,206, disclose a process for the preparation of poly(1,4-cyclohexanedicarboxylate) polyesters with high trans-isomer content comprising heating, in the presence of a
30 suitable catalyst, an ester of trans-1,4-cyclohexanedicarboxylic acid and a diacyl derivative of an aromatic diol.

Avakian, U.S. Patent No. 4,555,540, discloses flame retardant blends of aromatic polycarbonates and

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polyesters incorporating certain phosphorous containing materials for stability.

5 Nelson, U.S. Patent No. 4,760,107, discloses resin compositions comprising at least one aromatic polycarbonate resin, at least one polyester resin and a mixture of at least one polyol and at least one epoxide, the latter being necessary in the mixture to combat yellowing.

10 Copending application, DeRudder, U.S. Serial No. 06/947,671 filed on December 30, 1986, discloses low temperature impact resistant compositions of an aromatic polycarbonate resin, a polyester resin derived from a cyclohexane dimethanol and a hexacarboxylic dicarboxylic acid, and an impact modifier comprising a core-shell
15 acrylate (co-) polymer. The polyesters of the DeRudder compositions differ from alkane diol cyclohexane-dicarboxylate-based resins of the present invention.

20 Copending application, DeRudder et al, U.S. Serial No. 07/271,222 filed on November 14, 1988, now allowed, discloses in Example 19 a comparative composition comprising poly(1,4-butylene terephthalate), poly(bisphenol-A carbonate) and ACRYLOID® KM 653, also known as PARALOID® EXL 3691 (Rohm & Haas Company) which did not have acceptable gloss properties.

25 Copending applications, U.S. Serial Nos. 07/271,246 filed on November 14, 1988, and 07/356,356 filed on May 29, 1989, disclose polyester/polycarbonate blends modified by combinations of at least two different organosiloxane-based polyorganosiloxane/polyvinyl-based
30 or diene rubber-based graft copolymers. However, the polyester resins of the present invention differ because they comprise alkane diol/cyclohexanedicarboxylate-based units.

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A shortcoming of the previous compositions has been their inability to withstand gamma-radiation without the necessary addition of property enhancers at the sacrifice of tensile, flexural, and impact properties along with a loss of transparency.

Many of these shortcomings are overcome by the various embodiments of the compositions of the present invention. The unmodified compositions of the present invention are homogeneous and transparent, and all of the compositions of the present-invention exhibit desirable stiffness and impact properties.

SUMMARY OF THE INVENTION

According to the present invention, there are provided compositions comprising (A) a first polyester resin comprising the reaction product of (a) at least one straight chain, branched, or cycloaliphatic C_2 - C_{10} alkane diol or chemical equivalent thereof; and (b) at least one cycloaliphatic diacid or chemical equivalent thereof; and (B) an aromatic polycarbonate resin, an aromatic polyester carbonate resin, an aromatic dihydric phenol sulfone carbonate resin, or a mixture of any of the foregoing.

In a preferred embodiment, polyester (A) is the reaction product of (a) at least one straight chain or branched C_2 - C_{10} alkane diol and (b) as above.

Also contemplated by the invention are compositions as described above further comprising (C) an effective modulus modifying amount of (a) a core-shell multi-stage polymer having a rubbery core derived from an acrylate or (meth)acrylate, diene or a mixture of any of the foregoing and a vinyl-based polymer or copolymer outer shell; (b) a vinyl cyanide-conjugated diolefin-alkyl aromatic terpolymer; or (c) a combination of (a)

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and (b). Additionally compositions comprising components (A), (B), and (C) above and (D) an additional polyester resin which may be same as or different than (A) are provided.

5 In preferred embodiments, the compositions consist essentially of components (A) and (B), components (A), (B), and (C), or components (A), (B), (C), and (D).

In another embodiment, component (A)(a) can comprise at least one straight chain or branched C₂-C₁₀
10 alkane diol or chemical equivalent thereof.

DETAILED DESCRIPTION OF THE INVENTION

The diols useful in the preparation of the first polyester resins (A) of the present invention are
15 straight chain, branched, or cycloaliphatic but preferably straight chain or branched alkane diols and may contain 2 to 10 carbon atoms. Examples of such glycols include but are not limited to ethylene glycol; propylene glycol, i.e., 1,2- and 1,3-propylene glycol;
20 butane diol, i.e., 1,3- and 1,4-butane diol; diethylene glycol; 2,2-dimethyl-1,3-propane diol; 2-ethyl, 2-methyl, 1,3-propane diol; 1,3- and 1,5-pentane diol; dipropylene glycol; 2-methyl-1,5-pentane diol; 1,6-hexane diol; 1,4-cyclohexane dimethanol and particularly its cis- or
25 trans-enantiomers; triethylene glycol; 1,10-decane diol; and mixtures of any of the foregoing. Particularly preferred is 1,4-butanediol. If a cycloaliphatic diol or chemical equivalent thereof and particularly 1,4-cyclohexane dimethanol or chemical equivalent thereof are
30 to be used as the diol component, it is preferred that a mixture of cis to trans enantiomer thereof, ranging from 1 to 4 to 4 to 1, and preferably, a ratio of 1 to 3 is used.

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Chemical equivalents of these diols include esters and ethers such as dialkyl esters, diaryl esters, polytetramethylene oxide, and the like.

The diacids (A)(b) useful in the preparation of the polyester resins (A) of the present invention are cycloaliphatic diacids. This is meant to include carboxylic acids having two carboxyl groups each of which is attached to a saturated carbon in a saturated ring. A preferred diacid is 1,4-cyclohexanedicarboxylic acid and most preferred is trans-1,4-cyclohexane dicarboxylic acid as further explained below.

Cyclohexanedicarboxylic acids and their chemical equivalents can be prepared, for example, by the hydrogenation of cycloaromatic diacids and corresponding derivatives such as isophthalic acid or terephthalic acid in a suitable solvent, water or acetic acid at room temperature and at atmospheric pressure using suitable catalysts such as rhodium supported on a suitable carrier of carbon or alumina. See, Freifelder et al, Journal of Organic Chemistry, 31, 3438 (1966); U.S. Patent Nos. 2,675,390 and 4,754,064. They may also be prepared by the use of an inert liquid medium in which a phthalic acid is at least partially soluble under reaction conditions and a catalyst of palladium or ruthenium in carbon or silica, or by the hydrogenation of an alkali salt of trimellitic anhydride. See, U.S. Patent Nos. 2,888,484 and 3,444,237.

Typically in the hydrogenation, two enantiomers are obtained in which the carboxylic acid groups are in cis- or trans- positions. The cis- and trans-enantiomers can be separated by crystallization with or without a solvent, for example, n-heptane, or by distillation. The cis-enantiomer tends to blend better; however, the trans-enantiomer has higher melting and crystallization

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temperatures and is especially preferred. Mixtures of the cis- and trans-enantiomers are useful herein as well, and preferably when such a mixture is used, the trans-enantiomer will comprise at least about 75 parts by weight and the cis-enantiomer will comprise the remainder based upon 100 parts by weight of cis- and trans-enantiomer combined.

When the mixture of enantiomers or more than one diacid is used, a copolyester or a mixture of two polyesters for use as component (A) may be used.

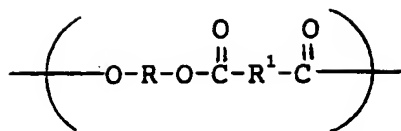
Chemical equivalents of the diacids include esters, e.g., dialkyl esters, diaryl esters, anhydrides, acid chlorides, acid bromides, and the like. The preferred chemical equivalents comprise the dialkyl esters of the cycloaliphatic diacids, and the most preferred chemical equivalent comprises the dimethyl ester of the acid, particularly dimethyl-trans-1,4-cyclohexanedicarboxylate.

Dimethyl-1,4-cyclohexanedicarboxylate can be obtained by ring hydrogenation of dimethylterephthalate, and two enantiomers having the carboxylic acid groups in the cis or trans- positions are obtained. The enantiomers can be separated as above, and the trans-enantiomer is especially preferred for the reasons above. Mixtures of the enantiomers are suitable as explained above and preferably in the amounts as explained above.

The polyester resins (A) of the present invention are typically obtained through the condensation or ester interchange polymerization of the diol or diol equivalent component (A)(a) with the diacid or diacid equivalent component (A)(b) and have recurring units of the formula

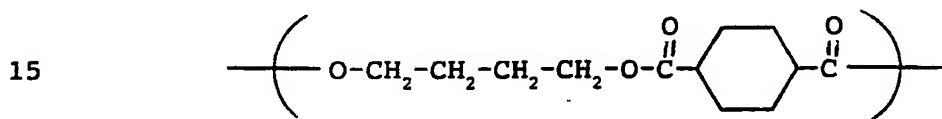
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wherein R represents an alkyl or cycloalkyl radical
 5 containing 2 to 10 carbon atoms and which is the residue
 of a straight chain, branched, or cycloaliphatic alkane
 diol having 2 to 10 carbon atoms or chemical equivalents
 thereof; and

R¹ is a cycloaliphatic radical which is the
 10 decarboxylated residue derived from a cycloaliphatic
 diacid or chemical equivalent thereof. They particularly
 have recurring units of the formula



wherein R from above is derived from 1,4-butane diol; and
 wherein R¹ from above is a cyclohexane ring derived from
 cyclohexanedicarboxylate or a chemical equivalent thereof
 20 and is selected from the cis- or trans-enantiomers
 thereof.

All such polyesters can be made following the
 teachings of, for example, U.S. Patent Nos. 2,465,319 and
 3,047,539.

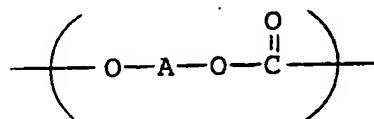
25 The reaction is generally run with an excess of
 the diol component and in the presence of a suitable
 catalyst such as a tetrakis(2-ethyl hexyl)titanate, in a
 suitable amount, typically about 20 to 200 ppm of
 titanium based upon the final product.

30 The polycarbonate resin component (B) can
 comprise non-aromatic as well as aromatic forms. With
 respect to aromatic polycarbonate resins, these can be
 made by those skilled in this art or can be obtained from
 a variety of commercial sources. They may be prepared by

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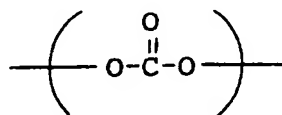
reacting a dihydroxy compound such as a dihydric phenol
and/or a polyhydroxy compound with a carbonate precursor,
such as phosgene, a haloformate or a carbonate ester such
as a diester of carbonic acid. Typically, they will have
5 recurring structural units of the formula



10 wherein A is a divalent aromatic radical of the dihydric
phenol employed in the polymer producing reaction.
Preferably, the aromatic polymers have an intrinsic
viscosity ranging from 0.30 to 1.0 dl/g (measured in
methylene chloride at 25°C). Dihydric phenols are meant
15 to include mononuclear or polynuclear aromatic compounds
containing two hydroxy radicals, each of which is
attached to a carbon atom of an aromatic nucleus.
Typically, dihydric phenols include 2,2-bis-(4-hydroxy-
phenyl)propane; 2,2-bis-(3,5-dimethyl-4-hydroxy-
20 phenyl)propane; 4,4'-dihydroxy-diphenylether; bis(2-
hydroxyphenyl)methane; mixtures thereof and the like.
The preferred aromatic carbonate polymer as component (B)
is a homopolymer derived from 2,2-bis(4-hydroxyphenyl)-
propane(bisphenol-A), poly(bisphenol-A carbonate).

25 Poly(ester-carbonate) resins for use in the
invention are known and can be obtained commercially.
Generally, they are copolyesters comprising recurring
carbonate groups:

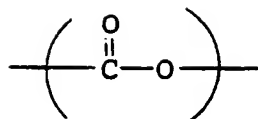
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carboxylate groups:

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and aromatic carbocyclic groups in the linear polymer chain, in which at least some of the carboxylate groups and at least some of the carbonate groups are bonded directly to ring carbon atoms of the aromatic carbocyclic groups. These poly(ester carbonates), in general, are prepared by reacting a difunctional carboxylic acid, such as phthalic acid; isophthalic acid; terephthalic acid; homophthalic acid; o-, m-, and p-phenylenediacetic acid; the polynuclear aromatic acids, such as diphenic acid; 1,4-naphthalic acid; mixtures of any of the foregoing; and the like, with a dihydric phenol and a carbonate precursor, of the types described above. A particularly useful poly(ester carbonate) is derived from bisphenol-A, isophthalic acid, terephthalic acid, or a mixture of isophthalic acid and terephthalic acid, or the reactive derivatives of these acids such as terephthaloyl dichloride, isophthaloyl dichloride, or a mixture thereof, and phosgene. The molar proportions of dihydroxy diaryl units to benzenedicarboxylate units to carbonate units can range from 1:0.30-0.80:0.70-0.20 and the molar range of terephthalate units to isophthalate units can range from 9:1 to 2:8 in this preferred family of resins.

The aromatic dihydric phenol sulfone resins useful as component (B) are a family of resins which can be made by those skilled in this art. For example, homopolymers of dihydric phenol, and a dihydroxydiphenol sulfone and a carbonate precursor as well as copolymers of a dihydric phenol and a carbonate precursor can be made according to the description in Schnell et al, U.S. Patent No. 3,271,367. A preferred material is made by

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polymerizing bis-(3,5-dimethyl-4-hydroxy phenyl) sulfone, alone or especially in combination with bisphenol-A with phosgene or a phosgene precursor, in accordance with the description in Fox, U.S. Patent No. 3,737,409.

- 5 Especially preferred is a copolymer made by reacting 40 to 99 weight percent of the sulfone and 1 to 60 weight percent of the bisphenol with phosgene.

Mixtures of any of the foregoing polycarbonate resins are suitable for use as component (B) as well.

- 10 The modifiers (C)(a) of the present invention comprise core-shell multi-stage polymers. The modifier core can comprise an acrylate or a (meth)acrylate, a diene, or a mixture of the foregoing.

- 15 In a preferred embodiment, the core is polymerized from a C₁ to C₆ alkyl acrylate resulting in an acrylic rubber core having a T_g below about 10°C and preferably it contains cross-linking monomer and/or graft-linking monomer. The preferred acrylate is n-butyl acrylate.

- 20 The cross-linking monomer is a polyethylenically unsaturated monomer having a plurality of addition polymerizable reactive groups all of which polymerize at substantially the same rate of reaction. Suitable cross-linking monomers include polyacrylic and 25 poly(methacrylic esters) of polyols such as butylene diacrylate and dimethacrylate, trimethylol propane trimethacrylate and the like, di- and tri-vinyl benzene, vinyl acrylate and methacrylate and the like. The preferred cross-linking monomer is butylene diacrylate.

- 30 The graft-linking monomer is a polyethylenically unsaturated monomer having a plurality of addition 5 polymerizable reactive groups, at least one of which polymerizes at a substantially different rate of polymerization from at least one other of said reactive

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groups. The function of the graft-linking monomer is to provide a residual level of unsaturation in the elastomeric phase, particularly in the latter stages of polymerization, and consequently, at or near the surface of the elastomer particles. When the rigid thermoplastic shell stage is subsequently polymerized at the surface of the elastomer, the residual unsaturated, addition polymerizable reactive group contributed by the graft-linking monomer participates in the subsequent reaction so that at least a portion of the rigid shell stage is chemically attached to the surface of the elastomer.

Among the effective graft-linking monomers are allyl group-containing monomers of allyl esters of ethylenically unsaturated diacids, such as allyl acrylate, allyl methacrylate, diallyl maleate, diallyl fumarate, diallyl itaconate, allyl acid maleate, allyl acid fumarate, and allyl acid itaconate. Somewhat less preferred are the diallyl esters of polycarboxylic acids which do not contain polymerizable unsaturation. The preferred graft-linking monomers are allyl methacrylate and diallyl maleate. The final or outer shell stage monomer can be comprised of C_1 - C_{16} methacrylate, styrene, acrylonitrile, alkyl acrylates, alkyl methacrylate, dialkyl methacrylate, and the like. Preferably, the final outer shell stage monomer includes a major portion of a C_1 - C_4 alkyl methacrylate.

One type of preferred core-shell multi-stage polymer (C)(a) has only two stages, the first stage or core being polymerized from a monomer system comprising butylene diacrylate as a cross-linking agent, allyl methacrylate or diallyl maleate as a graft-linking agent and with a final stage or outer shell of polymerized methyl methacrylate. A preferred two stage core-shell multi-stage polymer of this type is commercially

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available under the tradename, ACRYLOID® KM 330, also known as PARALOID® EXL 3330, from Rohm & Haas Company.

These core-shell multi-stage polymers are prepared sequentially by emulsion polymerization techniques wherein each successive outer stage or shell coats the previous stage polymer. By way of illustration, the monomeric C_1 - C_6 acrylate, the cross-linking monomer and the graft-linking monomer are copolymerized in water in the presence of a free-radical generating catalyst and a polymerization regulator which serves as a chain transfer agent at a temperature on the order of from 15°C to 80°C. The first elastomeric phase is formed in situ to provide a latex of the core copolymer.

Thereafter, the second rigid thermoplastic phase monomers are added and are emulsion polymerized with the core copolymer latex to form the core-shell multi-stage polymers. More detailed description of the preparation of the acrylate-based core-shell multi-stage polymers for use herein as component (C) are found in U.S. Patent Nos. 4,034,013 and 4,096,202.

In another preferred embodiment, the amorphous copolymer resin for use herein as component (C)(a) comprises a diene-based and preferably a butadiene-based core-shell multi-stage polymer resin. These diene-based core shell multi-stage polymers generally comprise a conjugated diene-based core, an intermediate graft shell of polymerized vinyl monomer units and a final or outer shell comprised of a polymerized monomeric component selected from the group consisting of an alkyl acrylate, preferably a C_1 - C_6 alkyl acrylate; an alkyl methacrylate, preferably a C_1 - C_6 alkyl methacrylate; acrylic acid; methacrylic acid; or a mixture of any of the foregoing with a cross-linking monomer.

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More particularly, the core stage of diene or butadiene-based core-shell multi-stage polymer component (C)(a) comprises polymerized conjugated diene units of a copolymer of polymerized diene units with polymerized units of a vinyl aromatic compound or mixtures of such compounds. Suitable conjugated dienes for use in said core stage include butadiene, isoprene, 1,3-pentadiene and the like. Illustrative vinyl aromatic compounds include styrene, alphas-methylstyrene, vinyl toluene, paramethylstyrene, and the like and esters of acrylic or methacrylic acid. The core of these copolymers should comprise a major portion of diene units. The preferred core-shell multi-stage polymer of this type includes a core of a styrene-butadiene copolymer having a molecular weight within the range of about 150,000 to 500,000. The core stage may also include a cross-linking monomer.

Although it is optional but preferred, the butadiene-based core-shell polymer may include a second intermediate stage of a polymerized vinyl monomer grafted to the core stage. Suitable vinyl monomers for use in the second intermediate shell stage include, but are not limited to, styrene, vinyl toluene, alphas-methylstyrene, halogenated styrene, naphthalene, or divinylbenzene. Styrene and vinyl cyanide compounds such as acrylonitriles, methacrylonitriles, and alpha-halogenated acrylonitriles, are especially preferred. These vinyl monomers can be used either alone or in admixture.

The final or outer shell stage of the diene-based core-shell multi-stage polymer comprises polymerized units of a monomeric compound selected from the group consisting of alkyl acrylates, especially C₁-C₆ alkyl acrylate; alkyl methacrylate, especially C₁-C₆ alkyl methacrylates; acrylic acid; methacrylic acid; or a mixture of any of the foregoing together with a cross-

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linking monomer. More particularly, the monomeric compound may be a C₁-C₆ alkyl acrylate, e.g., methyl acrylate, ethyl acrylate, hexyl acrylate, and the like; a C₁-C₆ alkyl methacrylate, e.g., methyl methacrylate, ethyl methacrylate, hexyl methacrylate, and the like; acrylic acid or methacrylic acid. Methyl methacrylate is preferred.

In addition to the monomeric compound, the final or outer shell stage of the diene-based core shell multi-stage polymer also includes a cross-linking monomer. The cross-linking monomer, as described above, is a polyethylenically unsaturated monomer having a plurality of addition polymerizable reactive groups, all of which polymerize at substantially the same reaction rate. Suitable cross-linking monomers include polyacrylic and poly methacrylic acid esters of polyols such as butylene diacrylate and dimethacrylate, trimethylol propane trimethacrylate and the like, divinyl- and trivinylbenzene, vinyl acrylate and methacrylate and the like. The preferred cross-linking monomer is butylene diacrylate.

A particularly preferred core-shell multi-stage polymer for use as component (C)(a) herein is a core-shell polymer having a core polymerized from butadiene and styrene, methylmethacrylate and divinylbenzene, a second, intermediate stage or shell polymerized from styrene, and a third stage or outer shell polymerized from methyl methacrylate and 1,3-butylene glycol dimethacrylate. Such a commercially available core-shell multi-stage polymer is ACRYLOID® KM 653, also known as PARALOID® EXL 3691, from Rohm and Haas Co.

The diene-based core-shell multi-stage polymers are also prepared sequentially by emulsion polymerization techniques wherein each successive stage or shell coats

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the previous stage polymer. The diene-based core-shell multistage polymers and the methods for their preparation are more fully described in U.S. Patent No. 4,180,494.

The modifiers (C)(b) of the present invention
5 comprise acrylonitrile-butadiene-styrene (ABS) graft copolymers well known to those of ordinary skill in the art.

Particularly suitable ABS impact modifier can be produced according to the procedures as set forth in
10 U.S. Patent No. 4,764,563.

These ABS impact modifiers are prepared by grafting particular ratios of styrene and acrylonitrile on butadienebased rubber substrates.

Specifically, these impact modifiers are ABS
15 graft copolymer resins prepared by graft polymerizing particular ratios of styrene and acrylonitrile in the presence of particular styrene-butadiene rubber substrates.

The butadiene-based rubber substrates useful in
20 preparing such impact modifiers are conventional copolymers of styrene and butadiene which optionally include up to 15 weight percent of acrylonitrile and/or an alkyl acrylate in which the alkyl group contains 4 or more carbon atoms, and comprise from 78 to 95 weight
25 percent butadiene and from 22 to 5 weight percent styrene. The rubber substrate may further include up to 2 weight percent of additional copolymerizable cross-linking monomers such as divinylbenzene, triallyl-cyanurate or the like, up to 2 weight percent of chain
30 transfer agents, such as tertiary dodecyl mercaptan, and up to 2 weight percent of graft enhancers such as alkyl methacrylate, diallylmaleate and the like. Diene polymer and copolymer rubbers are well known and widely employed commercially for a number of purposes. The preparation

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of such rubbers may be accomplished by any of a variety of processes well known and conventionally used. Particularly used are emulsion polymerization processes which provide the rubber in latex form suitable for use in subsequent graft polymerization processes.

These preferred ABS-type impact modifiers are prepared by graft polymerizing from about 40 to about 70, preferably from 47 to 61 parts by weight of a grafting monomer mixture comprising a monovinyl aromatic compound (MVA), such as styrene, a methyl styrene, p-methyl styrene or a combination thereof and an ethylenically unsaturated nitrile (EUN) such as acrylonitrile and/or methacrylonitrile in the presence of 100 parts by weight of butadiene-based rubber substrate. The impact modifier is thus a high rubber graft copolymer having a rubber content of from about 50 to about 80 weight percent, preferably from 62 to 78 weight percent and, correspondingly, a graft ionomer component or superstrate of from about 50 to 20, preferably from 48 to 22 weight percent.

The weight ratio of the MVA to the EUN in the grafting monomer mixture will be in the range of from 3:1 to 5:1 and preferably, from 3.8:1 to 4.2:1.

This graft polymerization of the MVA/EUN monomer mixture in the presence of the rubbery substrate may be carried out by any of the graft polymerization processes well known and widely used in the polymerization art for preparing ABS resins, including emulsion, suspension and bulk processes. Typical of such processes are emulsion graft polymerization processes wherein the grafting monomers are added together with surfactants and chain transfer agents as desired, to an emulsion latex of the rubbery substrate and polymerized using an initiator. The initiator may be any of the

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commonly used free-radical generators including peroxides such as alcumyl peroxide or azo initiators such as azobisisobutyronitrile. Alternatively, any of the variety of redox polymerization catalysts such as the
5 combination of cumene hydroperoxide with ferrous sulfate and sodium formaldehyde sulfoxylate which are well known and widely used in such processes may be employed. The graft polymerization process used in the preparation of these ABS impact modifiers, as well as those processes
10 used in coagulating and isolating the impact modifier for further use, are thus well known and conventional, and the application of such processes to the preparation of these impact modifiers for further use, are thus well known and conventional, and apparent to those skilled in
15 the art.

The ABS impact polymer suitable for use in the present invention may also comprise a styrenic polymer which comprises a rigid portion and a rubber portion. The rigid portion is formed from at least two
20 ethylenically unsaturated monomers, one of which comprises styrene and/or substituted styrene. Preferred substituted styrenes include, but are not limited to, halogen-substituted styrene, particularly wherein the halogen is substituted on the aromatic ring, alpha-methyl
25 styrene and para-methyl styrene. The other ethylenically unsaturated monomer which is used in forming the rigid portion may be selected from acrylonitrile, substituted acrylonitriles, acrylates, alkyl, substituted acrylates, methacrylates, alkyl substituted methacrylates, and
30 ethylenically unsaturated carboxylic acids, diacids, dianhydrides, acid esters, diacid esters, amides, imides and alkyl and aryl substituted imides. Preferably, the second monomer which is used to form the rigid portion is selected from the group consisting of acrylonitrile,

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methacrylonitrile, alkyl methacrylates, malaic, anhydride, maleimide, alkyl maleimides and aryl maleimides, and mixtures thereof. It is further preferred that the rigid portion is formed from about 60 to about 95 weight percent, and more preferably 60 to 80 weight percent of the styrene and/or substituted styrene monomers, and from about 5 to about 40 weight percent, and more preferably 20 to 40 weight percent of the second monomer.

The rubber portion may be formed from polymers or copolymers of one or more conjugated dienes, copolymers of conjugated dienes and non-diene vinyl monomers, alkyl acrylate polymers, and copolymers of ethylenically unsaturated olefins and non-conjugated diene polymers (EPDM) rubbers. A preferred rubber portion includes polybutadiene.

The styrenic polymer component may be formed such that the rigid portion is grafted to the rubber portion. Alternatively, the rigid portion may be blended with the rubber portion. When the rigid portion is blended with the rubber portion, it is preferred that the rubber portion has been previously grafted with one or more grafting monomers. Accordingly, the styrenic polymer component may be so produced by any method known in the art, for example, emulsion, bulk, mass or suspension polymerization processes. It is preferred that the styrenic polymer component contains from about 10 to 90 weight percent of the rubber portion and from about 10 to 90 weight percent of the rigid portion, based on the rubber portion and the rigid portion. more preferably, the styrenic polymer component comprises from about 40 to about 80 weight percent of the rubber portion and from about 20 to about 60 weight percent of the rigid

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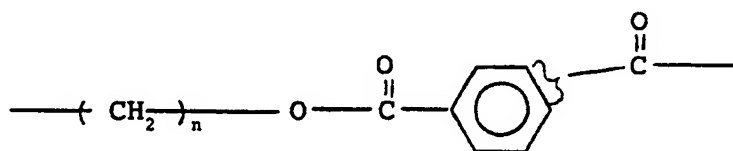
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portion, based on the rubber portion and the rigid portion.

Combinations of the above core-shell multi-stage modifiers and ABS modifiers are suitable for use in the present invention as well.

In another aspect, the compositions of the present invention may include a second polyester resin (D) which may be the same as or different than (A) in addition to components (A), (B) and (C).

Polyesters (D) suitable for use herein may include those of (A) above and may be saturated or unsaturated. They are preferably, however, derived from an aliphatic or cycloaliphatic diol, or mixtures thereof, containing from 2 to about 10 carbon atoms, and at least one aromatic dicarboxylic acid. Preferred saturated polyester resins comprise the reaction product of a dicarboxylic acid or a chemical equivalent thereof and a diol. Preferred polyesters are derived from an aliphatic diol and an aromatic dicarboxylic acid and have repeated units of the following general formula:



wherein n is an integer of from 2 to 4.

The most preferred polyesters are poly(ethylene terephthalate) and poly(1,4-butylene terephthalate).

Also contemplated herein are the above polyesters with minor amounts, e.g., from 0.5 to about 2 percent by weight, of units derived from aliphatic acid and/or aliphatic polyols to form copolyesters. The aliphatic polyols include glycols, such as poly(ethylene glycol). All such polyesters can be made following the

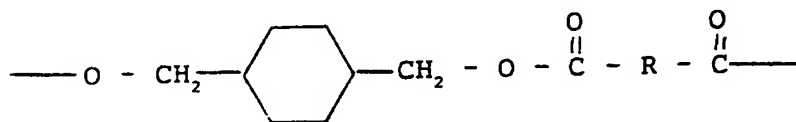
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teachings of, for example, U.S. Patent Nos. 2,465,319 and 3,047,539.

The polyesters which are derived from a cycloaliphatic diol and an aromatic dicarboxylic acid are prepared, for example, by condensing either the cis- or trans-isomer (or mixtures thereof) of, for example, 1,4-cyclohexanedimethanol with an aromatic dicarboxylic acid to produce a polyester having recurring units of the following formula:

10



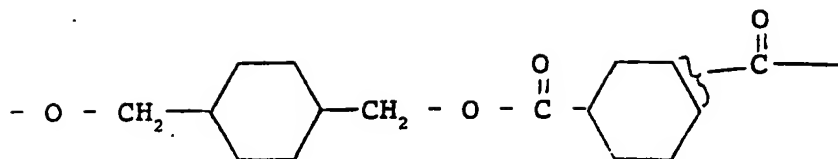
wherein the cyclohexane ring is selected from the cis- and trans-isomers thereof and R represents an aryl radical containing 6 to 20 carbon atoms and which is the decarboxylated residue derived from an aromatic dicarboxylic acid.

Examples of aromatic dicarboxylic acids represented by the decarboxylated residue R are isophthalic or terephthalic acid, 1,2-di(p-carboxyphenyl) ethane, 4,4'-dicarboxydiphenyl ether, etc., and mixtures of these. All of these acids contain at least one aromatic nucleus. Acids containing fused rings can also be present, such as in 1,4- or 1,5-naphthalene-dicarboxylic acids. The preferred dicarboxylic acids are terephthalic acid or a mixture of terephthalic and isophthalic acids.

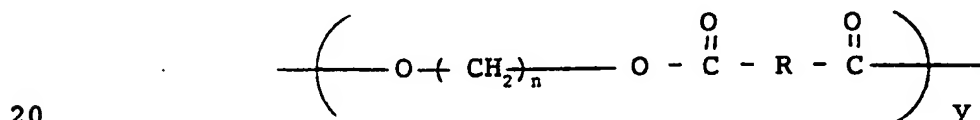
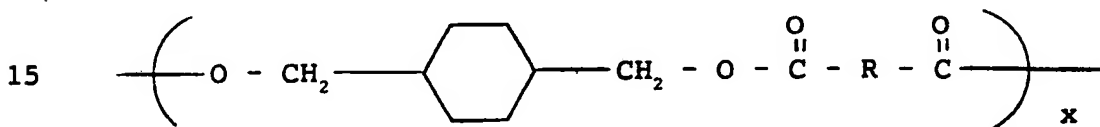
Another preferred polyester may be derived from the reaction of either the cis- or trans-isomer (or a mixture thereof) of 1,4-cyclohexanedimethanol with a mixture of isophthalic and terephthalic acids. Such a polyester would have repeating units of the formula:

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5 Still another preferred polyester is a copolyester derived from a cyclohexanedimethanol, an alkylene glycol and an aromatic dicarboxylic acid. These copolyesters are prepared by condensing either the cis- or trans-isomer (or mixtures thereof) of, for example,
 10 1,4-cyclohexanedimethanol and an alkylene glycol with an aromatic dicarboxylic acid so as to produce a copolyester having units of the following formula:

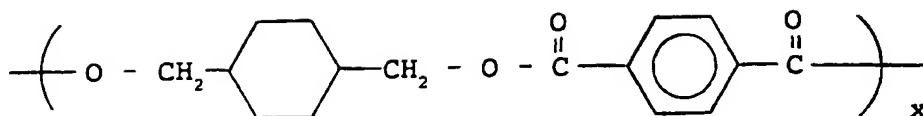


wherein the cyclohexane ring is selected from the cis- and trans-isomers thereof, R is as previously defined, n is an integer of 2 to 4, the x units comprise from about
 25 10 to about 90 percent by weight and the y units comprise from about 90 to about 10 percent by weight.

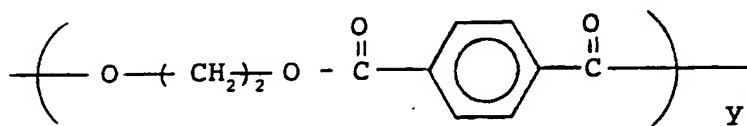
Such a preferred copolyester may be derived from the reaction of either the cis- or trans-isomer (or mixtures thereof) of 1,4-cyclohexanedimethanol and
 30 ethylene glycol with terephthalic acid in a molar ratio of 1:2:3. These copolyesters have repeating units of the following formula:

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5



wherein x and y are as previously defined.

10 The polyesters described herein are either commercially available or can be produced by methods well known in the art, such as those set forth in, for example, U.S. Patent No. 2,901,466.

15 The polyesters used herein as component (D) have an intrinsic viscosity of from about 0.4 to about 2.0 dl/g as measured in a 60:40 phenol:tetrachloroethane mixture or similar solvent at 23°C-30°C.

Special mention is made of blends comprising the compositions of the present invention. Additionally, 20 the compositions of the present invention may be molded, extruded, or thermoformed into articles by conventional methods known to one of ordinary skill in the art.

In the two component compositions of the present invention, component (A), the first polyester 25 resin, comprises a minor portion and component (B), the polycarbonate resin, comprises a major portion of the polyester/polycarbonate composition. Preferably, the first polyester component (A) comprises from about 1 to about 49 parts by weight and the polycarbonate resin 30 comprises from about 99 to about 51 parts by weight based upon 100 parts by weight of (A) and (B) combined, and most preferably, the first polyester component (A) comprises from about 1 to about 25 by weight and especially 25 parts by weight and the polycarbonate

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component (B) comprises from about 99 to about 75 parts by weight and especially 75 parts by weight based upon 100 parts by weight of (A) and (B) combined.

In the modified compositions of the present invention, component (A) comprises a minor amount and component (B) comprises a major amount of (A) and (B) combined as above and components (A) and (B) combined comprise from about 80 to about 99 parts by weight and component (C) comprises from about 20 to about 1 part by weight based upon 100 parts by weight of (A), (B) and (C) combined.

In the modified compositions containing an additional polyester resin (D), component (A) comprises a minor amount and component (B) comprises a major amount of (A) and (B) combined as above and components (A) and (B) combined comprise from about 50 to about 75 parts by weight, component (C) comprises from about 1 to about 20 parts by weight, and component (D) comprises from about 5 to about 35 parts by weight based upon 100 parts by weight of (A), (B), (C), and (D) combined.

Conventional processes for mixing thermoplastic polymers can be used for the manufacture of compositions within the present invention. For example, the compositions can be manufactured using any suitable mixing equipment, kneaders, or extruders under conditions known to one of ordinary skill in the art.

Additionally, additives such as flow promoters, antioxidants, nucleating agents, other stabilizers, reinforcing agents, fillers, pigments, flame retardants, or combinations of any of the foregoing may be added to compositions of the present invention.

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DESCRIPTION OF THE PREFERRED EMBODIMENTS

The following examples illustrate the invention without limitation. All parts are given by weight unless otherwise indicated. Impact strengths are represented as notched and unnotched Izods according to ASTM-D-256 or Dynatup impact at room temperature (RT) (23°C) unless otherwise specified. Tensile properties are measured by ASTM-D-638 and flexural properties are measured by ASTM-D-790. Appearances are recorded as either opaque, transparent or clear and colorless.

EXAMPLE 1

A well mixed dry blend of 25.0 parts of poly(1,4-butylene-trans-1,4-cyclohexanedicarboxylate) (PBCD) (melt viscosity 1100 poise at 250°C), 74.65 parts of a polycarbonate resin (PC) (poly(bisphenol-A carbonate) Lexan® 141 - General Electric Company - Pittsfield, MA), and 0.35 part of a stabilizer package was extruded on a 2.5" HPM extruder operating at 100 rpm with barrel zones at 250°C.

The extruded blend was observed to be homogeneous and transparent. Tensile, notched Izod, and Dynatup bars were molded on a 3.5 oz. Van Dorn injection molding machine at 250°C barrel temperatures and 75°C mold temperature in a 30 second cycle.

Properties are summarized in Table 1.

COMPARATIVE EXAMPLE 1A*

The procedure of Example 1 was followed substituting 100.0 parts by weight of PBCD (melt viscosity 2400 poise at 250°C) for the dry blend.

Properties are summarized in Table 1.

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COMPARATIVE EXAMPLE 1B*

The procedure of Example 1 was followed substituting a dry blend of 99.65 parts of poly(1,4-butylene terephthalate) (PBT) (Valox® 315 - General Electric Company) and 0.35 part of a stabilizer package. Properties are summarized in Table 1.

COMPARATIVE EXAMPLE 1C*

The procedure of Example 1 was followed substituting a dry blend of 98.97 parts of PBCD (melt viscosity 2500 poise at 250°C) and 1.03 parts of stabilizer package.

Properties are summarized in Table 1.

COMPARATIVE EXAMPLE 1D*

The procedure of Example 1 was followed substituting a dry blend of 98.97 parts by weight of PBT (Valox® 315 - General Electric Company) and 1.03 parts of a stabilizer package.

Properties are summarized in Table 1.

COMPARATIVE EXAMPLE 1E*

The procedure of Example 1 was followed substituting a dry blend of 100.0 parts of PC (poly(bisphenol-A carbonate) Lexan® 141 - General Electric Company) and a trace of a stabilizer package.

Properties are summarized in Table 1.

EXAMPLE 2

A copolyester comprising a 23:77 ratio of cis- to trans-1,4-butylene-1,4-cyclohexanedicarboxylate monomers was prepared by reacting 515.0 parts of trans-dimethyl-trans-1,4cyclohexane dicarboxylate and 265.0 parts of a 60:40 mixture of cis- and trans-dimethyl-1,4-

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cyclohexanedicarboxylate (DMCD-HP - Eastman Chemical - Rochester, NY) with 550.0 parts of 1,4-butane diol in the present of 1.0 part of titanium in the form of tetra (2-ethylhexyl) titanate under the interchange condition, recovering the excess butane diol at 260°C under vacuum. A C^{13} NMR analysis indicated that the resultant copolyester contains 23 percent of the cis-cyclohexane dicarboxylate residue. Differential scanning calorimetry indicated a peak crystallization temperature of 132°C and a heat of fusion of 18.3 J/g.

A well mixed dry blend of 25.0 parts of the copolyester from above and 75.0 parts of a polycarbonate resin (poly(bisphenol-A carbonate) - Lexan® 141 - General Electric Company) was extruded and molded as in Example 1.

The test pieces were transparent as molded. Some of the test pieces were annealed in an oven for 4 hours at 100°C without turning opaque. Other test pieces were annealed in an oven for 4 hours at 120°C without turning opaque, but some bubbles developed in these pieces due to the presence of moisture.

Properties are summarized in Table 1.

EXAMPLE 3

The procedure of Example 2 was followed substituting a dry blend of 25.0 parts of PBCD (poly(1,4-butylene-trans-1,4-cyclohexanedicarboxylate)) and 75.0 parts of a polycarbonate resin (poly(bisphenol-A carbonate) - Lexan® 141 - General Electric Company).

The test pieces were transparent as molded, but upon annealing, turned opaque due to crystallization of the polyester component.

Properties are summarized in Table 1.

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Example 1 shows that PBCD/PC compositions retain the transparency of polycarbonates. Examples 1-3, when compared with Comparative Examples 1A*-1E*, illustrate the improvement in flexural modulus PBCD/PC compositions provide over that of the individual components and over other polyester resins such as PBT, as well as the excellent retention of practical impact strength as measured by unnotched Izod impact strength and Dynatup impact strength and the retention of transparency of the compositions of the present invention.

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TABLE 1
PBCD/PC COMPOSITIONS

<u>Example</u>	<u>1</u>	<u>1A*</u>	<u>1B*</u>	<u>1C*</u>	<u>1D*</u>	<u>1E*</u>	<u>2</u>	<u>3</u>
<u>Composition</u>								
PBCD ^A / viscosity (p)	25.0/1100	100.0/2400	-	98.97/2500	-	-	-	25.0/-
PBCD ^B	-	-	-	-	-	-	25.0	-
PBT ^C	-	-	99.65	-	98.97	-	-	-
PC ^D	74.65	-	-	-	-	100.0	75.0	75.0
Stabilizers	0.35	-	0.35	1.03	1.03	trace	-	-
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<u>Properties</u>								
Appearance ^E as molded	T	O	O	-	-	T	-	-
Appearance ^E after annealing 4 hrs. @ 100°C	O	-	-	-	-	-	T	O
Appearance ^F after annealing 4 hrs. @ 120°C	O	-	-	-	-	-	TB	O
Flexural Modulus (Kpsi)	442	107	340	66	340	340	-	-

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TABLE 1 (cont'd)
PBCD/PC COMPOSITIONS

<u>Example</u>	<u>1</u>	<u>1A*</u>	<u>1B*</u>	<u>1C*</u>	<u>1D*</u>	<u>1E*</u>	<u>2</u>	<u>3</u>
Flexural Strength (Kpsi)	17	4.3	12	-	-	14	-	-
Tensile Strength (Kpsi)	7.1	4.7	7.5	3.9	7.5	9	-	-
Tensile Elongation (%)	76	337	200	450	300	130	-	-
Dynatup Impact @ 23°C at Max Load (fpi)	61	-	-	-	-	47	-	-
Izod Impact Notched @ 23°C (fpi)	1.0	0.5	1.0	-	-	15	-	-
Notched @ -30°C (fpi)	-	-	-	0.6	0.5	-	-	-
Unnotched @ 23°C (fpi)	NB	NB	NB	-	-	NB	-	-
D/B Transition °C	-	-	-	30	30	-	-	-

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TABLE 1 (cont'd)

- A - poly(1,4-butylene-trans-1,4-cyclohexane-dicarboxylate).
- B - copolyester of 23:77 cis to trans poly(1,4-butylene-1,4-cyclohexanedicarboxylate) monomers.
- C - poly(1,4-butylene terephthalate) - Valox® 315 - General Electric Company.
- D - poly(bisphenol-A carbonate) - Lexan® 141 - General Electric Company.
- E - O = opaque; T = transparent; TB = transparent with bubbles.

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EXAMPLE 4

The procedure of Example 1 was followed substituting a dry blend of 39.0 parts of PBCD (poly(1,4-butylene-trans-1,4-cyclohexanedicarboxylate) melt viscosity 1100 poise at 250°C), 49.25 parts of PC (poly(bisphenol-A carbonate) Lexan® 141 - General Electric Company), 10.5 parts of a core-shell multi-stage polymer (C/S modifier) (core = polymerized butadiene and styrene, methylmethacrylate and divinylbenzene second stage/shell = polymerized styrene outer shell = polymerized methylmethacrylate and 1,3-butylene glycol dimethacrylate - ACRYLOID® KM 653, also known as PARALOID® EXL 3691 - Rohm & Haas Company - Philadelphia, PA) and 1.25 parts of a stabilizer package.

The extruded composition was observed to be opaque in appearance. Properties are summarized in Table 2.

COMPARATIVE EXAMPLE 4A*

The procedure of Example 1 was followed substituting a dry blend of 39.0 parts of PBT (poly(1,4-butylene terephthalate) - Valox® 315 - General Electric Company), 49.25 parts of PC (poly(bisphenol-A carbonate) - Lexan® 141 - General Electric Company), 10.5 parts of C/S modifier (ACRYLOID® KM 653, also known as PARALOID® EXL 3691 - Rohm & Haas Company), and 1.25 parts of a stabilizer package.

Properties are summarized in Table 2.

EXAMPLE 5

The procedure of Example 1 was followed substituting a dry blend of 38.34 parts of PBCD (poly(1,4-butylene-trans-1,4-cyclohexanedicarboxylate) melt viscosity 2500 poise at 250°C), 46.0 parts of PC

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(poly(bisphenol-A carbonate) Lexan® 141 - General Electric Company), 14.0 parts of CIS modifier (ACRYLOID® KM 653, also known as PARALOID® EXL 3691 - Rohm & Haas Company), and 1.66 parts of a stabilizer package.

5 Properties are summarized in Table 2.

COMPARATIVE EXAMPLE 5A*

The procedure of Example 1 was followed substituting a dry blend of 38.34 parts of PBT (poly(1,4-
10 butylene terephthalate) - Valox® 315 - General Electric Company), 46.0 parts of PC (poly(bisphenol-A carbonate) - Lexan® 141 - General Electric Company), 14.0 parts of CIS modifier (ACRYLOID® KM 653, also known as PARALOID® EXL 3691 - Rohm & Haas Company) and 1.66 parts of a
15 stabilizer package.

Properties are summarized in Table 2.

EXAMPLE 6

The procedure of Example is followed substituting a dry blend of 39.0 parts of PBCD (poly(1,4-
20 butylene-trans-1,4cyclohexanedicarboxylate) melt viscosity 1100 poise at 250°C), 49.25 parts of PC (poly(bisphenol-A carbonate) - Lexan® 141 - General Electric Company), 10.5 parts of an acrylonitrile-
25 butadiene-styrene graft copolymer modifier (ABS-BLENDEX® 338 General Electric Company), and 1.25 parts of a stabilizer package.

Typical properties will be substantially the same as those of Example 4 and are summarized in Table 2.

30

Examples 4, 5 and 6 demonstrate that modified PBCD/PC compositions retain higher than average stiffness and excellent impact strength as well as excellent low temperature properties. When compared with Comparative

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Exanples 1A* and 1C*, they illustrate that the modified compositions perform better than the individual components.

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TABLE 2
MODIFIED PBCD/PC COMPOSITIONS

<u>Example</u>	<u>4</u>	<u>4A*</u>	<u>5</u>	<u>5A*</u>	<u>6</u>
<u>Composition</u>					
PBCD ^A	39.0	-	-	-	39.0
PBCD ^B	-	-	38.34	-	-
PBT ^C	-	39.0	-	38.34	-
PC ^D	49.25	49.25	46.0	46.0	49.25
Modifier ^E	10.5	10.5	14.0	14.0	-
Modifier ^F	-	-	-	-	10.5
Stabilizers	1.25	1.25	1.66	1.66	1.25

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TABLE 2 (cont'd)

<u>Example</u> <u>Properties</u>	<u>4</u>	<u>4A*</u>	<u>5</u>	<u>5A*</u>	<u>6</u>
Appearance ^c	0	0	-	-	same as Example 4
Flexural Modulus (Kpsi)	307	296	295	290	same as Example 4
Flexural Strength (Kpsi)	10.7	12.3	-	-	same as Example 4
Tensile Strength (Kpsi)	4.7	7.7	6.7	6.7	same as Example 4
Tensile Elongation (%)	117	120	150	150	same as Example 4
Dynatup Impact @ 230C at Max Load (fpi)	43	40	-	-	same as Example 4
Izod Impact Notched @ 23°C (fpi)	15.2	13.3	-	-	same as Example 4
Notched @ -30°C (fpi)	-	-	14.0	12.0	same as Example 4
Unnotched @ 23°C (fpi)	NB	NB	-	-	same as Example 4
D/B Transition°C	-	-	-65	-55	same as Example 4

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TABLE 2 (cont'd)

- A - poly(1,4-butylene-trans-1,4-cyclohexane-dicarboxylate) - melt viscosity 1100 poise at 250°C.
- B - poly(1,4-butylene-trans-1,4-cyclohexane-dicarboxylate) - melt viscosity 2500 poise at 250°C.
- C - poly(1,4-butylene terephthalate) - Valox® 315 - General Electric Co.
- D - poly(bisphenol-A carbonate) - Lexan® 141 - General Electric Co.
- E - core-shell multi-stage polymer - core = polymerized butadiene and styrene, methylmethacrylate and divinylbenzene - second stage/shell = polymerized styrene - outer shell = polymerized methylmethacrylate and 1,3-butylene glycol dimethacrylate (ACRYLOID® KM 653, also known as PARALOID® EXL 3691 - Rohm & Haas Company - Philadelphia, PA)
- F - Acrylonitrile-butadiene-styrene graft copolymer (ABS) BLENDEX® 338 - General Electric Co.
- G - O = opaque; T transparent
- F - Typical properties obtain will be substantially the same as those of Example 4.

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EXAMPLE 7

The procedure of Example 1 was followed substituting a dry blend of 10.0 parts of PBCD (poly(1,4-butylene-trans-1,4-cyclohexanedicarboxylate) (melt viscosity -2500 poise at 250°C), 28.34 parts of PBT (poly(1,4-butylene terephthalate) Valox® 315 - General Electric Company), 46.0 parts of PC (poly(bisphenol-A carbonate) - Lexan® 141 - General Electric Company), 14.0 parts of C/S modifier (ACRYLOID® KM 653, also known as PARALOID® EXL 3691 - Rohm & Haas Company), and 1.66 parts of stabilizer package.

Properties are summarized in Table 3.

EXAMPLE 8

The procedure of Example 1 was followed substituting 20 parts of PBCD (poly(1,4-butylene-trans-1,4-cyclohexanedicarboxylate) (melt viscosity -2500 poise at 250°C), 18.34 parts of PBT (poly(1,4-butylene terephthalate) - Valox® 315 General Electric Company), 46.0 parts of PC (poly(bisphenol-A carbonate) - Lexan® 141 - General Electric Company), 14.0 parts of C/S modifier (ACRYLOID® KM 653, also known as PARALOID® EXL 3691 - Rohm & Haas Company), and 1.66 parts of stabilizer package.

Properties are summarized in Table 3.

EXAMPLE 9

The procedure of Example 1 was followed substituting 28.34 parts of PBCD (poly(1,4-butylene-trans-1,4-cyclohexanedicarboxylate) (melt viscosity 2500 poise at 250°C), 10.0 parts of PBT (poly(1,4-butylene terephthalate) - Valox® 315 General Electric Company), 46.0 parts of PC (poly(bisphenol-A

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carbonate) - Lexan® 141 - General Electric Company), 14.0 parts of C/S modifier (ACRYLOID® KM 653, also known as PARALOID® EXL 3691 - Rohm & Haas Company), and 1.66 parts of stabilizer package.

5 Properties are summarized in Table 3.

EXAMPLE 10

The procedure of Example 1 is followed substituting a dry blend of 10.0 parts of PBCD (poly(1,4-butylene-trans1,4-cyclohexanedicarboxylate) melt viscosity 2500 poise at 250°C), 28.34 parts of PBT (poly(1,4-butylene terephthalate) Valox® 315 - General Electric Company), 46.0 parts of acrylonitrile-butadiene-styrene graft copolymer modifier (ABS BLENDEX® 338 - General Electric Company), and 1.66 parts of a stabilizer package.

Typical properties will be substantially the same as those of Example 7 and are summarized in Table 3.

20 Examples 7, 3, 9 and 10 demonstrate that modified PBCD/PC/PE compositions retain higher than average stiffness, excellent impact strength, and excellent tensile properties at all temperatures.

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TABLE 3
MODIFIED PBCD/PC/PE COMPOSITIONS

<u>Example</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10^F</u>
<u>Composition</u>				
PBCD ^A	10.0	20.0	28.34	10.0
PBT ^B	28.34	18.34	10.0	28.34
PC ^C	46.0	46.0	46.0	46.0
Modifier ^D	14.0	14.0	14.0	-
Modifier ^E	-	-	-	14.0
Stabilizers	1.66	1.66	1.66	1.66
<u>Properties</u>				
Flexural Modulus (Kpsi)	290	310	320	same as Example 7
Tensile Strength (Kpsi)	6.7	6.5	6.5	same as Example 7
Tensile Elongation (%)	110	150	140	same as Example 7
Izod Impact Notched @ -30°C (fpi)	13.0	13.0	14.0	same as Example 7
D/B Transition°C	-55	-60	-65	same as Example 7

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TABLE 3 (cont'd)

- A - poly(1,4-butylene-trans-1,4-cyclohexane-dicarboxylate) melt viscosity 2500 poise.
- B - poly(1,4-butylene terephthalate) - Valox® 315 - General Electric Co.
- C - poly(bisphenol-A carbonate) - Lexan® 141 - General Electric Co.
- D - core-shell multi-stage polymer - core = polymerized butadiene and styrene, methylmethacrylate and divinylbenzene - second stage = polymerized styrene - outer shell = polymerized methylmethacrylate and 1,3-butylene glycol dimethacrylate - (ACRYLOID® KM 653, also known as PARALOID® EXL 3691 - Rohm & Haas Company Philadelphia, PA).
- E - acrylonitrile-butadiene-styrene graft copolymer (ABS) BLENDEX® 338 - General Electric Co.
- F - typical properties obtained will be substantially the same as those in Example 7.

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EXAMPLE 11

A well mixed dry blend of 50.0 parts of a copolyester of a 25:75 ratio of cis- to trans-1,4-cyclohexanedimethanol and dimethyl trans-1,4-cyclohexane-
5 dicarboxylate (PCCD) having a melt viscosity of 3000 poise at 250°C and 50.0 parts of a polycarbonate resin (poly(bisphenol-A carbonate) - Lexan® 141 - General Electric Company) was extruded and molded as in Example 1.

10 The molded pieces were transparent. Differential scanning colorimetry indicated that the blend had essentially no crystallinity and showed no tendency to crystallize at annealing temperatures.

Properties are summarized in Table 4.

15

EXAMPLE 12

A well mixed dry blend of 49.8 parts of PCCD, a copolyester of a 25:75 ratio of cis- to trans-1,4-cyclohexanedimethanol and dimethyl trans-1,4-cyclohexane-
20 dicarboxylate having a melt viscosity of 3000 poise at 250°C, 49.8 parts of a polycarbonate resin (poly(bisphenol-A carbonate) - Lexan® 141 - General Electric Company) and 0.4 part of a stabilizer package was extruded, molded, and tested as in Example 1.

25 Properties are summarized in Table 4.

EXAMPLE 13

A well mixed dry blend of 49.975 parts of a copolyester of PCCD, a 25:75 ratio of cis- to trans-1,4-cyclohexanedimethanol and dimethyl trans-1,4-cyclohexane-
30 dicarboxylate having a melt viscosity of 3000 poise at 250°C, 49.975 parts of a polycarbonate resin (poly(bisphenol-A carbonate) - Lexan® 141 - General Electric Company) modified with a small amount of blue

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dye to mask a slightly yellow hue, and 0.05 part of stabilizer package was extruded, molded and tested as in Example 1.

The molded pieces were water clear and colorless. Properties are summarized in Table 4.

Examples 11-13 demonstrate the combination of transparency and excellent ductility of the unmodified compositions of the present invention.

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TABLE 4
PCCD/PC COMPOSITIONS

<u>Example</u>	<u>11</u>	<u>12</u>	<u>13</u>
<u>Composition</u>			
PCCD ^A	50.0	49.8	49.975
PC ^B	50.0	49.8	49.975
Stabilizers	-	0.4	0.05
Dye ^C	-	-	Trace
<u>Properties</u>			
Appearance ^D	T	T	C
Melt Viscosity @ 250°C (poise)	-	10600	-
Flexural Modulus (Kpsi)	-	237	-
Flexural Strength (Kpsi)	-	11.4	-
Tensile Strength Yield/ Break (Kpsi)	-	7.0/-	7.26/6.33
Tensile Elongation	-	150	108
Dynatup Impact @ 23°C at Max Load (fpi)	-	34.0	-
Total	-	38.1	-
Izod Impact Notched @ 23°C (fpi)	-	38.9	-
Notched @ -30°C (fpi)	-	15.8	-

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TABLE 4 (cont'd)

- A - copolyester of 25:75 cis:trans 1,4-cyclohexane-dimethanol and dimethyl trans-1,4-cyclohexane-dicarboxylate - melt viscosity 3000 poise at 250°C.
- B - poly(bisphenol-A carbonate) - Lexan® 141 - General Electric Co.
- C - Blue dye to mask yellow hue.
- D - O = opaque; T = transparent; C = water clear and colorless.

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EXAMPLE 14

The general procedure of Examples 11-13 is repeated substituting a dry blend of 39.0 parts of PCCD, a copolyester of a 25:75 ratio of cis- to trans-1,4-cyclohexanedimethanol and dimethyl trans-1,4-cyclohexanedicarboxylate having a melt viscosity of 3000 poise at 250°C, 49.25 parts of PC (poly(bisphenol-A carbonate) - Lexan® 141 - General Electric Company), 10.5 parts of a core shell multi-stage polymer (C/S modifier) (core = polymerized butadiene and styrene, methylmethacrylate and divinylbenzene second stage/shell polymerized styrene - outer shell = polymerized methylmethacrylate and 1,3-butylene glycol dimethacrylate ACRYLOID® KM 653, also known as PARALOID® EXL 3691 - Rohm & Haas Company - Philadelphia, PA) and 1.25 parts of a stabilizer package as indicated in Table 5.

Substantially the same results as Examples 11-13 will be obtained, except stiffness is reduced and the sample is opaque.

20

EXAMPLE 15

The general procedure of Examples 11-13 is repeated substituting a dry blend of 39.0 parts of PCCD (a copolyester of a 25:75 ratio of cis- to trans-1,4-cyclohexane dicarboxylate having a melt viscosity of 3000 poise at 250°C), 49.25 parts of PC (poly(bisphenol-A carbonate) - Lexan® 141 - General Electric Company), 10.5 parts of an acrylonitrile-butadienestyrene graft copolymer modifier (ABS BLENDEX® 338 - General Electric Company), and 1.25 parts of a stabilizer package as indicated in Table 5.

Substantially the same results as Examples 11-13 will be obtained, except stiffness is reduced and the sample is opaque.

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EXAMPLE 16

The general procedure of Examples 11-13 is repeated substituting a dry blend of 10.0 parts of PCCD, a copolyester of a 25:75 ratio of cis- to trans-1,4-cyclohexanedimethanol and dimethyl trans-1,4-cyclohexanedicarboxylate having a melt viscosity of 3000 poise at 250°C, 28.34 parts of PBT (poly(1,4-butylene terephthalate) - Valox® 315 - General Electric Company), 46.0 parts of PC (poly(bisphenol-A carbonate) - Lexan® 141 - General Electric Company), 14.0 parts of C/S modifier (ACRYLOID® KM 653, also known as PARALOID® EXL 3691 - Rohm & Haas Company), and 1.66 parts of a stabilizer package as indicated in Table 5.

Substantially the same results as Examples 11-13 will be obtained, except stiffness is reduced, and the sample is opaque.

EXAMPLE 17

The procedure of Example 1 is followed substituting a dry blend of 10.0 parts of PCCD, a copolyester of a 25:75 ratio of cis- to trans-1,4-cyclohexanedimethanol and dimethyl trans-1,4-cyclohexanedicarboxylate having a melt viscosity of 3000 poise at 250°C, 28.34 parts of PBT (poly(1,4-butylene terephthalate) - Valox® 315 - General Electric Company), 46.0 parts of acrylonitrile-butadienestyrene graft copolymer modifier (ABS - BLENDEX® 338 - General Electric Company), and 1.66 parts of a stabilizer package as indicated in Table 5.

Substantially the same results as Examples 11-13 will be obtained, except stiffness is reduced, and the sample is opaque.

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TABLE 5
MODIFIED PCCD/PC AND MODIFIED PCCD/PC/PBT COMPOSITIONS

<u>Example</u>	<u>14</u>	<u>15</u>	<u>16</u>	<u>17</u>
<u>Composition</u>				
PCCD ^A	39.0	39.0	10.0	10.0
PBT ^B	-	-	28.34	28.34
PC ^C	49.25	49.25	46.0	46.0
Modifier ^D	10.5	-	14.0	-
Modifier ^E	-	10.5	-	14.0
Stabilizers	1.25	1.25	1.66	1.66

A - copolyester of 25:75 cis:trans 1,4-cyclohexane-dimethanol and dimethyl trans-1,4-cyclohexane-dicarboxylate - melt viscosity 3000 poise at 250°C.

B - poly(1,4-butylene terephthalate) - Valox® 315 - General Electric Co.

C - poly(bisphenol-A carbonate) - Lexan® 141 - General Electric Co.

D - core-shell multi-stage polymer - core = polymerized butadiene and styrene, methylmethacrylate and divinylbenzene - second stage/shell = polymerized styrene - outer shell = polymerized methylmethacrylate and 1,3-butylene glycol dimethacrylate - (ACRYLOID® KM 653, also known as PARALOID® EXL 3691 - Rohm & Haas Company - Philadelphia, PA).

E - Acrylonitrile-butadiene-styrene graft copolymer (ABS) - BLENDEX® 338 - General Electric Co.

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All patents, publications, applications and test methods mentioned above are hereby incorporated by reference.

5 Many variations of the present invention will suggest themselves to those skilled in this art in light of the above, detailed description. All such obvious variations are within the full intended scope of the appended claims.

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CLAIMS:

1. A composition comprising
 - (A) a first polyester resin comprising the reaction product of
 - (a) at least one straight chain,
5 branched, or cycloaliphatic C_2C_{-10} alkane diol or chemical equivalent thereof; and
 - (b) at least one cycloaliphatic diacid or chemical equivalent thereof; and
 - (B) an aromatic polycarbonate resin, an
10 aromatic polyester carbonate resin, an aromatic dihydric phenol sulfone carbonate resin, or a mixture of any of the foregoing.
2. A composition as defined in Claim 1 wherein said alkane diol (A)(a) is selected from the group consisting of ethylene glycol, propylene glycol, butylene glycol, and cyclohexane dimethanol.
3. A composition as defined in Claim 2 wherein said alkane diol (A)(a) comprises 1,4-butylene glycol.
4. A composition as defined in Claim 1 wherein said diacid (A)(b) comprises 1,4-cyclohexanedicarboxylic acid.
5. A composition as defined in Claim 4 wherein said diacid (A)(b) comprises trans-1,4-cyclohexanedicarboxylic acid.
6. A composition as defined in Claim 4 wherein said diacid (A)(b) comprises a mixture of cis- and trans-1,4-cyclohexanedicarboxylic acid.
7. A composition as defined in Claim 1 wherein said diacid chemical equivalent (A)(b) comprises a dialkyl ester of the diacid.
8. A composition as defined in Claim 7 wherein said dialkyl ester (A)(b) comprises dimethyl-1,4-cyclohexanedicarboxylate.

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9. A composition as defined in Claim 8 wherein said dialkyl ester (A)(b) comprises dimethyl-trans-1,4-cyclohexanedicarboxylate.

10. A composition as defined in Claim 8 wherein said dialkyl ester (A)(b) comprises a mixture of dimethyl-cis- and dimethyl-trans-1,4-cyclohexanedicarboxylate.

11. A composition as defined in Claim 1 wherein said first polyester resin (A) comprises poly(1,4-butylene-1,4-cyclohexanedicarboxylate).

12. A composition as defined in Claim 11 wherein said first polyester resin (A) comprises poly(1,4-butylenetrans-1,4-cyclohexanedicarboxylate).

13. A composition as defined in Claim 11 wherein said first polyester resin (A) comprises a copolymer comprising monomers of 1,4-butylene-cis-1,4-cyclohexanedicarboxylate and 1,4-butylene-trans-1,4-cyclohexanedicarboxylate.

14. A composition as defined in Claim 1 wherein component (B) comprises an aromatic polycarbonate resin.

15. A composition as defined in Claim 14 wherein component (B) comprises a poly(bisphenol-A carbonate) resin.

16. A composition as defined in Claim 1 wherein component (A) comprises a minor amount and component (B) comprises a major amount of (A) and (B) combined.

17. A composition as defined in Claim 16 wherein component (A) comprises from about 1 to about 49 parts by weight and component (B) comprises from about 51 to about 99 parts by weight based upon 100 parts by weight of (A) and (B) combined.

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18. A composition as defined in Claim 17 wherein component (A) comprises about 25 parts by weight and component (B) comprises about 75 parts by weight based upon 100 parts by weight of (A) and (B) combined.

19. An article molded from a composition as defined in Claim 1.

20. An article extruded from a composition as defined in Claim 1.

21. An article thermoformed from a composition as defined in Claim 1.

22. A composition consisting essentially of
(A) a first polyester resin comprising the reaction product of

(a) at least one straight chain,
5 branched, or cycloaliphatic C_2-C_{10} alkane diol or chemical equivalent thereof; and

(b) at least one cycloaliphatic diacid or chemical equivalent thereof; and

(B) an aromatic polycarbonate resin, an
10 aromatic polyester carbonate resin, an aromatic dihydric phenol sulfone carbonate resin, or a mixture of any of the foregoing.

23. A composition as defined in Claim 1 wherein said alkane diol or chemical equivalent thereof comprises 1,4-cyclohexanedimethanol or a chemical equivalent thereof.

24. A composition as defined in Claim 23 wherein said alkane diol or chemical equivalent thereof comprises from about 20 to about 80 parts by weight of the cis-enantiomer of said alkane diol or chemical
5 equivalent thereof and from about 30 to about 20 parts by weight of the trans-enantiomer of said alkane diol or chemical equivalent thereof based upon 100 parts by weight of said-cis- and said trans-enantiomers combined.

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25. A composition as defined in Claim 24 wherein said cis-enantiomer comprises about 25 parts by weight and said trans-enantiomer comprises about 75 parts by weight of said cis- and trans-enantiomers combined.

26. A composition as defined in Claim 1 further comprising reinforcing filler, pigment, flame retardant, stabilizer, nucleating agent or a combination of any of the foregoing.

27. A composition comprising

(A) a first polyester resin comprising the reaction product of

(a) at least one straight chain,
5 branched, or cycloaliphatic C_2-C_{10} alkane diol or chemical equivalent thereof; and

(b) at least one cycloaliphatic diacid or chemical equivalent thereof;

(B) an aromatic polycarbonate resin, an
10 aromatic polyester carbonate resin, an aromatic dihydric phenol sulfone carbonate resin, or a mixture of any of the foregoing; and

(C) an effective modulus modifying amount of

(a) a core-shell multi-stage polymer having
15 a rubbery core derived from an acrylate or (meth)acrylate, a diene or a mixture of any of the foregoing; and a vinyl-based polymer or copolymer outer shell;

(b) a vinyl cyanide-conjugated diolefin-
20 alkyl aromatic terpolymer; or

(c) a combination of (a) and (b).

28. A composition as defined in Claim 27 wherein said alkane diol (A)(a) is selected from the group consisting of ethylene glycol, propylene glycol, butylene glycol, and cyclohexane dimethanol.

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29. A composition as defined in Claim 28 wherein said alkane diol (A)(a) comprises 1,4-butylene glycol.

30. A composition as defined in Claim 27 wherein said diacid (A)(b) comprises 1,4-cyclohexanedicarboxylic acid.

31. A composition as defined in Claim 30 wherein said diacid (A)(b) comprises trans-1,4-cyclohexanedicarboxylic acid.

32. A composition as defined in Claim 30 wherein said diacid (A)(b) comprises a mixture of cis- and trans-1,4-cyclohexanedicarboxylic acid.

33. A composition as defined in Claim 27 wherein said diacid chemical equivalent (A)(b) comprises a dialkyl ester of the diacid.

34. A composition as defined in Claim 33 wherein said dialkyl ester (A)(b) comprises dimethyl-1,4-cyclohexanedicarboxylate.

35. A composition as defined in Claim 34 wherein said dialkyl ester (A)(b) comprises dimethyl-trans-1,4-cyclohexanedicarboxylate.

36. A composition as defined in Claim 34 wherein said dialkyl ester (A)(b) comprises a mixture of dimethyl-cis- and dimethyl-trans-1,4-cyclohexanedicarboxylate.

37. A composition as defined in Claim 27 wherein said first polyester resin (A) comprises poly(1,4-butylene-1,4-cyclohexanedicarboxylate).

38. A composition as defined in Claim 37 wherein said first polyester resin (A) comprises poly(1,4-butylenetrans-1,4-cyclohexanedicarboxylate).

39. A composition as defined in Claim 37 wherein said first polyester resin (A) comprises a copolymer comprising monomers of 1,4-butylene-cis-1,4-

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5 cyclohexanedicarboxylate and 1,4-butylene-trans-1,4-cyclohexanedicarboxylate.

40. A composition as defined in Claim 27 wherein component (B) comprises an aromatic polycarbonate resin.

41. A composition as defined in Claim 39 wherein component (B) comprises a poly(bisphenol-A carbonate) resin.

42. A composition as defined in Claim 27 wherein said modifier (C)(a) comprises a core-shell multi-stage polymer having a rubbery core derived from n-butylacrylate, butadiene, or a mixture thereof and a
5 (meth)acrylate (co-) polymer outer shell.

43. A composition as defined in Claim 42 wherein said modifier (C)(a) comprises a core-shell multi-stage polymer having a core comprising polymerized butadiene-styrene, an intermediate shell comprising
5 polymerized styrene, and an outer shell comprising polymerized methylmethacrylate and 1,3-butylene glycol dimethacrylate.

44. A composition as defined in Claim 27 wherein said modifier (C)(b) comprises a terpolymer of acrylonitrile, butadiene, and styrene.

45. A composition as defined in Claim 27 wherein component (A) comprises a minor amount and component (B) comprises a major amount of (A) and (B) combined and components (A) and (B) combined comprise
5 from about 99 to about 80 parts by weight and component (C) comprises from about 1 to about 20 parts by weight of (A), (B) and (C) combined.

46. An article molded from a composition as defined in Claim 27.

47. An article extruded from a composition as defined in Claim 27.

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48. An article thermoformed from a composition as defined in Claim 27.

49. A composition consisting essentially of

(A) a first polyester resin comprising the reaction product of

(a) at least one straight chain,
5 branched, or cycloaliphatic C_2-C_{10} alkane diol or chemical equivalent thereof; and

(b) at least one cycloaliphatic diacid or chemical equivalent thereof;

(B) an aromatic polycarbonate resin, an
10 aromatic polyester carbonate resin, an aromatic dihydric phenol sulfone carbonate resin, or a mixture of any of the foregoing; and

(C) an effective modulus modifying amount of

(a) a core-shell multi-stage polymer
15 having a rubbery core derived from an acrylate or (meth)acrylate, a diene or a mixture of any of the foregoing; and a vinyl-based polymer or copolymer outer shell;

(b) a vinyl cyanide-conjugated diolefin-
20 alkenyl aromatic terpolymer; or

(c) a combination of (a) and (b).

50. A composition as defined in Claim 27 wherein said alkane diol or chemical equivalent thereof comprises 1,4-cyclohexanedimethanol or a chemical equivalent thereof.

51. A composition as defined in Claim 50 wherein said alkane diol or chemical equivalent thereof comprises from about 20 to about 80 parts by weight of the cis-enantiomer of said alkane diol or chemical
5 equivalent thereof and from about 80 to about 20 parts by weight of the trans-enantiomer of said alkane diol or

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chemical equivalent thereof based upon 100 parts by weight of said cis- and said trans-enantiomers combined.

52. A composition as defined in Claim 51 wherein said cis-enantiomer comprises about 25 parts by weight and said trans-enantiomer comprises about 75 parts by weight of said cis- and trans-enantiomers combined.

53. A composition as defined in Claim 27 further comprising reinforcing filler, pigment, flame retardant, stabilizer, nucleating agent, or a combination of any of the foregoing.

54. A composition comprising

(A) a first polyester resin comprising the reaction product of

(a) at least one straight chain,
5 branched, or cycloaliphatic C₂-C₁₀ alkane diol or chemical equivalent thereof; and

(b) at least one cycloaliphatic diacid or chemical equivalent thereof;

(B) an aromatic polycarbonate resin, an
10 aromatic polyester carbonate resin, an aromatic dihydric phenol sulfone carbonate resin, or a mixture of any of the foregoing;

(C) an effective modulus modifying amount of

(a) a core-shell multi-stage polymer
15 having a rubbery core derived from an acrylate or (meth)acrylate, a diene or a mixture of any of the foregoing; and a vinyl-based polymer or copolymer outer shell;

(b) a vinyl cyanide-conjugated diolefin-
20 alkyl aromatic terpolymer; or

(c) a combination of (a) and (b); and

(D) an additional polyester resin which may be the same as or different than (A).

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55. A composition as defined in Claim 54 wherein said alkane diol (A)(a) is selected from the group consisting of ethylene glycol, propylene glycol, butylene glycol, and cyclohexane dimethanol.

56. A composition as defined in Claim 54 wherein said alkane diol (A)(a) comprises 1,4-butylene glycol.

57. A composition as defined in Claim 54 wherein said diacid (A)(a) comprises 1,4-cyclohexanedicarboxylic acid.

58. A composition as defined in Claim 57 wherein said diacid (A)(b) comprises trans-1,4-cyclohexanedicarboxylic acid.

59. A composition as defined in Claim 57 wherein said diacid (A)(b) comprises a mixture of cis- and trans-1,4-cyclohexanedicarboxylic acid.

60. A composition as defined in Claim 54 wherein said dialkyl ester (A)(b) comprises a dialkyl ester of the diacid.

61. A composition as defined in Claim 60 wherein said dialkyl ester (A)(b) comprises dimethyl-1,4-cyclohexanedicarboxylate.

62. A composition as defined in Claim 61 wherein said dialkyl acid (A)(b) comprises dimethyl-trans-1,4-cyclohexanedicarboxylate.

63. A composition as defined in Claim 61 wherein said diacid chemical equivalent (A)(b) comprises a mixture of dimethyl-cis- and dimethyl-trans-1,4-cyclohexanedicarboxylate.

64. A composition as defined in Claim 54 wherein said first polyester resin (A) comprises poly(1,4-butylene-1,4-cyclohexanedicarboxylate).

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65. A composition as defined in Claim 64 wherein said first polyester resin comprises poly(1,4-butylene-trans-1,4-cyclohexanedicarboxylate).

66. A composition as defined in Claim 64 wherein said first polyester resin comprises a copolymer comprising monomers of 1,4-butylene-cis-1,4-cyclohexanedicarboxylate and 1,4-butylene-trans-1,4-cyclohexanedicarboxylate.

67. A composition as defined in Claim 54 wherein component (B) comprises an aromatic polycarbonate resin.

68. A composition as defined in Claim 67 wherein component (B) comprises a poly(bisphenol-A carbonate) resin.

69. A composition as defined in Claim 54 wherein said modifier (C)(a) comprises a core-shell multi-stage polymer having a rubbery core derived from n-butylacrylate, butadiene, or a mixture thereof and a (meth)acrylate (co-)polymer outer shell.

70. A composition as defined in Claim 69 wherein said modifier (C)(a) comprises a core-shell multi-stage polymer having a core comprising polymerized butadiene and styrene, an intermediate shell comprising polymerized styrene, and an outer shell comprising polymerized methylmethacrylate and 1,3-butylene glycol dimethacrylate.

71. A composition as defined in Claim 54 wherein said modifier (C)(b) comprises a terpolymer of acrylonitrile, butadiene, and styrene.

72. A composition as defined in Claim 54 wherein said additional polyester resin (D) comprises poly(1,4-butylene terephthalate).

73. A composition as defined in Claim 54 wherein component (A) comprises a minor amount and

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component (B) comprises a major amount of (A) and (B) combined and components (A) and (B) combined comprise
5 from about 50 to about 75 parts by weight, component (C) comprises from about 1 to about 20 parts by weight and component (D) comprises from about 5 to about 35 parts by weight based upon 100 parts by weight of (A), (B), (C) and (D) combined.

74. An article molded from a composition as defined in Claim 54.

75. An article extruded from a composition as defined in Claim 54.

76. An article thermoformed from a composition as defined in Claim 54.

77. A composition consisting essentially of

(A) a first polyester resin comprising the reaction product of

(a) at least one straight chain,
5 branched, or cycloaliphatic C_2-C_{10} alkane diol or chemical equivalent thereof; and

(b) at least one cycloaliphatic diacid or chemical equivalent thereof;

(B) an aromatic polycarbonate resin, an
10 aromatic polyester carbonate resin, an aromatic dihydric phenol sulfone carbonate resin, or a mixture of any of the foregoing;

(C) an effective modulus modifying amount of

(a) a core-shell multi-stage polymer
15 having a rubbery core derived from an acrylate or (meth)acrylate, a diene or a mixture of any of the foregoing; and a vinyl-based polymer or copolymer outer shell;

(b) a vinyl cyanide-conjugated diolefin-
20 alkyl aromatic terpolymer; or

(c) a combination of (a) and (b); and

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(D) an additional polyester resin which may be the same as or different than (A).

78. A composition as defined in Claim 54 wherein said alkane diol or chemical equivalent thereof comprises 1,4-cyclohexanedimethanol or a chemical equivalent thereof.

79. A composition as defined in Claim 78 wherein said alkane diol or chemical equivalent thereof comprises from about 20 to about 80 parts by weight of the cis-enantiomer of said alkane diol or chemical
5 equivalent thereof and from about 80 to about 20 parts by weight of the trans-enantiomer of said alkane diol or chemical equivalent thereof based upon 100 parts by weight of said cis- and said trans-enantiomers combined.

80. A composition as defined in Claim 79 wherein said cis-enantiomer comprises about 25 parts by weight and said trans-enantiomer comprises about 75 parts by weight of said cis- and trans-enantiomer combined.


81. A composition as defined in Claim 54 further comprising reinforcing filler, pigment, flame retardant, stabilizer, nucleating agent or a combination of any of the foregoing.

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INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 91/06098

I. CLASSIFICATION OF SUBJECT MATTER (If several classification symbols apply, indicate all) ⁶		
According to International Patent Classification (IPC) or to both National Classification and IPC Int.Cl. 5 C08L69/00; //(C08L69/00,67:02)		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁷		
Classification System	Classification Symbols	
Int.Cl. 5	C08L	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁸		
III. DOCUMENTS CONSIDERED TO BE RELEVANT⁹		
Category ¹⁰	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
X	PATENT ABSTRACTS OF JAPAN vol. 4, no. 50 (C-7)(532) 16 April 1980 & JP,A,55 023 125 (TORAY IND INC) 19 February 1980 see abstract ---	1,4-10, 14-22
X	EP,A,0 152 825 (GENERAL ELECTRIC COMPANY) 28 August 1985 see claims 1,12,22,24 ---	1-23
X	EP,A,0 273 151 (GENERAL ELECTRIC COMPANY) 6 July 1988 see page 4, line 8 - line 43; claims 1-5,7-11 ---	27,28, 30, 40-43, 45-50,53
X	EP,A,0 320 651 (GENERAL ELECTRIC COMPANY) 21 June 1989 see the whole document ---	54-81
-/-		
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IV. CERTIFICATION		
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	
11 MAY 1992	20. 05. 92	
International Searching Authority	Signature of Authorized Officer	
EUROPEAN PATENT OFFICE	DECOCKER L. 	

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)		Relevant to Claim No.
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